

QUANTITATIVE OR QUALITATIVE TRANSPORT PLANNING? AN INTERDISCIPLINARY GEOGRAPHIC PERSPECTIVE

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Abstract: The paper is an attempt to critical discuss of the evolution of transport planning notion in the research literature – including the geographical one. The author presents key points of this discipline and reviews the difficulties associated with qualitative research on mobility – a field usually characterized by rational behavior prompted by external factors and economic factors. The social sciences suggest that mobility results in outcomes driven by social and psychological needs. The author suggests that geography is an important element of the interdisciplinary approach needed to analyze transport behaviors in both qualitative and quantitative terms. Finally, the author discusses space syntax theory and its applicability in research on the effects of geographic space on mobility.

Keywords: geography, transport, space syntax, motion potential

Introduction

Issues associated with transport have been discussed by researchers from a wide variety of disciplines that attempt to model and forecast transport behaviors. Since the journey is an integral part of transport, it is expected that the transport sciences will be interested in the effects of various forms of movement on individuals and their decisions. Yet, most research studies focus on the understanding and description of optimal solutions designed for communities in the form of quantitative models describing reality. The author attempts to analyze the reasons behind the general preference for quantitative research over qualitative research. In addition, the paper provides a brief review of transport research and its effect on the current approach to research in this field. The search for effective solutions in the realm of mobility is also presented from a geographical point of view – a sensitive to the spatial context of this issue. Geography has a rich tradition of theoretical and empirical research in areas such as spatial integration, network analysis and behavioral science.

Public transport provides certain benefits from the perspective of sustainable development, however, the planning process is based on a classical approach that can distort analytical results and lead to a situation where the public transport network does not really meet the expectations of society. This prompts the following questions: Can this be changed? Can forecasts be made to include both qualitative and quantitative data? What role can geography play in research on mobility? After all, geography is an interdisciplinary science that functions at the intersection of many research disciplines. The last part of the paper suggests the use of space syntax theory in the modeling of spatial accessibility as it relates to public transport and the analysis of movement potential known as *through movement* in urban areas. Virtually every journey aboard a public transport vehicle begins and ends with walking. The ability to easily walk from one mode of transport to another at transport hubs affects the individual's choice of means of transport (Olszewski 2008). The development of a method designed to assess the effect of spatial structure on pedestrian traffic may be one way of finding a solution to the problem of qualitative context in mobility research.

While existing journey models are quite advanced, so-called soft quality issues are rarely considered in mobility research and research on the decisions involved in the process of choosing a mode of transport. There is a general lack of models that would be clearly applicable in Poland (Dudek, Rudnicki 2008). On the other hand, it seems that the issue of quality in transport research ought to be considered on a local scale in light of the fact that every urban area is unique and the definition of quality, as it applies to transport, may differ even within one country.

Evolution of transport planning

The task of individuals planning transport systems is to design systems that would be useful, efficient and effective and would meet the expectations of society. These may include its transport capability as well as its role in spatial management, environmental protection and social equality. Planning is essentially a linear process of problem solving and includes analyses, evaluations and implementations of optimal solutions. The transport planning process usually includes an assessment of journey potential, demographical and urban planning forecasts, and creation of alternative solutions designed to help identify the best possible option.

Advanced transport planning is closely associated with the emergence of the automobile as a means of transport in the 1920s (Kenneth 1985). The evaluation of projects and transport services in the context of economic development has come to dominate transport research ever since.

In order to better understand the spatial distribution of the means of production and demand, graphical models are used to explain the flow of traffic (Erlander, Stewart 1990). The best example of those is the sensitivity of demand for a journey relative to distance, as explained by the gravitational model. Detailed analyses of movement are also described using the laws of physics "borrowed" directly from the natural sciences. One example of this is the analogy with the flow of water, which is used to explain the flow of traffic.

The qualitative aspects of travel were not considered in transport planning until recently. The above mentioned analyses are based on a perception of mobility as a form of mass movement, which ought to be analyzed at a macro level (Rajé 2007). These fundamental notions remain valid today, but the range of criteria used to evaluate transport planning has expanded considerably. Early homogenous models of mobility have been replaced by analyses that involve non-motor vehicle travel, ecological considerations and social considerations. The economic basis of demand has been expanded to include the notion of customer satisfaction as the key forecasting factor (Bates 2000).

Quantitative descriptive variables – research directions in modern transport planning

The definition of the effectiveness of a transport system has changed over time. However, the creation of an effective system remains the basic task of transport planners, who tend to focus on quantitative criteria developed in the 1950s (Pas 1986). It is now important to identify the key elements of planning paradigms and to consider what role they ought to play today.

The analysis and modeling of the demand for transport are usually based on travel time and cost and both are used as parameters designed to explain human behavior (Pipkin 1986; Richardson 2005). According to this view, users of a transport system want to minimize their expenses and the time it takes to reach their destination. Other factors are rarely considered and tend to be viewed as secondary factors in terms of their ability to explain human behavior. Sometimes certain intermediate costs are considered – these include comfort, air conditioning, ambience, *etc.* An even greater simplification is obtained when travel time is converted into monetary value, which reduces the number of parameters to one (general costs). This type of approach leads to a very simple model of human behavior. Yet, this type of approach is very common in transport research, although it has its critics (McNally 2000). In summary, if analyses and models are based on strictly economic criteria, then this creates the risk of omitting other important factors at the project design stage.

In the field of transport research, travel times and costs are closely linked to the assumption that individuals make conscious decisions based on a rational assessment of various alternatives when planning a journey. This model reflects the notion that man is economically rational and that specific human behaviors in the realm of economics can be explained in terms of purely rational (optimal) choices – the idea that economic man means rational man (Wach 2010). Today the issue of quality is handled by fields such as psychology and marketing, which have made attempts over the last few decades to understand and describe the mechanisms behind human behaviors in the context of a cognitive paradigm.

Yet another cognitive notion in transport research is a theory that assumes that mobility is only driven by the desire to satisfy economic needs (Barber 1986). A mismatch between the location of supply and the location of demand prompts individuals to migrate or travel. Newer interpretations of this notion assume the existence of non-material needs such as the need to travel for recreational purposes. However,

the basic theory remains the same and serves as the key to understanding the difficulty traditional transport research has had in the analysis of subjective elements of mobility. The above mentioned theories rely on the assumption that every journey is forced upon travelers by external factors and that the experience of travel and the ambience involved are not important from a forecasting perspective. For example, one economic parameter is not sufficient to explain internal mobility (Mokhtarian, Salomon 2001; Ory, Mokhtarian 2005)

The time spent on a journey is also analyzed in economic terms. The optimization of transport systems is supposed to reduce travel time. This assumption makes it difficult for passive travelers to identify the effects of movement and the fact that the travel time might be used in other ways. Detailed research studies on human activity during travel were quite rare until recently (Lyons *et al.* 2007). This is a good point to distinguish between individual travel and group travel, as these two situations are different in terms of priorities, needs, expectations and perceptions of geographic space (Tuan Yi-Fu 1987).

The principal subject of discussion in transport planning is the attainment of quantitative success. Increased mobility is desirable due to its positive economic effect. While this basic notion is disputed to some extent in some research circles (Knoflachner 1999), it is likely that the fundamentals of transport science and planning will not change. Transport optimization models do not take into account the quality of travel, as it is subjectively described by passengers (Dudek, Rudnicki 2008). Any type of change in the perception of transport may require a new analysis of the role of quantitative and qualitative aspects of mobility.

Creative dimension of modeling

Despite many attempts to create rational, methodological and credible transport models, evaluation and forecasting in the planning process are not immune to manipulation. Criteria used as objective quantitative data are often used without an appropriate initial assessment of their usefulness based on subjective choices. Many research studies are designed to help understand the evaluation process by questioning the notion of rational decision making based on complete information. Information on available options may not be complete. Criteria may be weighted in a number of different ways. Coefficients may change due to internal and external circumstances, and decisions about destination, mode, time are not independent of each other (Pipkin 1986). Two aspects of planning may be subject to criticism: 1) variety of criteria used to make decisions, 2) means of processing them. In order to correctly understand the act of traveling, one can use criteria other than those used in transport planning today. This brings up the issue of the evaluation of qualitative factors (Duckenfield 2005; Gärling, Axhausen 2003).

The basic job of modeling tools is to reduce the complexity of reality. It takes a lot of effort to build a model based on the smallest number of parameters. The primacy of this argument creates the risk that some important aspects of reality will be omitted and certain erroneous simplifications and extrapolations will be made.

Planning has always involved a certain creative dimension. This is clearly visible in infrastructure projects as well as the development of transport services and their terms of use. The generation of development scenarios requires creative skills in order to produce attractive and effective solutions that match a given set of circumstances. However, creativity often encounters a variety of barriers or established ways of doing things. Furthermore, the creation of prognostic models based on subjective aspects of travel requires the establishment of norms in this area and a careful consideration of whether they will reflect user expectations and desires in an appropriate manner. The use of micro-simulation and task-oriented modeling can help in the analysis of mutual relationships and consequences of travel choices (Meyer 2001).

Interdisciplinary research – the geographical perspective on transport planning?

When considering ways to empirically capture and formulate qualitative factors useful in transport planning, several questions come to mind that serve as a basis for further discussion. First, how can one analytically capture subjective quality criteria? Second, how do they affect transport systems? A list of criteria is a good starting point in the attempt to construct models that consider both the quality and the subjectivity of the choice of a travel destination. In light of the multiplicity of terms and methods used in human mobility research, it is difficult to draw simple conclusions. Certainly the use of research papers from the fields of sociology and psychology can help. It is helpful to focus on the individual when attempting to understand various aspects of motivation and perception associated with the choice of the means of transport and the choice of destination. Nevertheless, this is just a certain idea to be considered at this point.

Transport is spatial in nature, which is why it is often the subject of research in geography. From the geographical perspective, the application of both quantitative and qualitative research methods may be viewed as either an advantage or disadvantage. One unique aspect of geography is its interdisciplinary nature, which creates an opportunity to look at a complex problem from a variety of perspectives. Another major advantage of geography is its spatial perspective as well as its focus on regional research, which can be quite helpful in the construction of complex transport models. While the procedure for creating models is somewhat standardized, most models are designed to meet the needs of a specific geographical area. The regional nature of geography may be helpful in the critical, and at the same time, realistic evaluation of the usefulness of a spatial model. A geographer with a keen knowledge of a given region may be able to better identify the modifications a given model needs to explain transport behaviors. However, the risk associated with interdisciplinary research is that certain key elements of analysis will be omitted due to the specific nature of a science at the intersection of many different fields of research.

One of the current trends in the geography of transport is an increase of the research studies number. However, the research literature also identifies a need to correlate research on transport with that in human geography (Knowles 2006; Preston, O'Connor 2008) due to a predominance of transport studies based on quantitative methods

(Goetz 2006). One reason for this predominance is technological progress in the field of computer science, which has made it possible to apply more powerful statistical methods (Sheppard 2001). Nevertheless, transport geography remains open to other research methods and the disparity between qualitative and quantitative studies can be reduced by more research in the social sciences (Aoyama *et al.* 2006). A number of papers on the geography of transport have been published in recent years that combine qualitative and quantitative research methods (Kwan 2000; Fowler 2006).

Space Syntax – analysis of the potential of pedestrian traffic

Space Syntax Theory was formulated in 1984 by Bill Hillier and Julienne Hanson at University College London. The theory is based on the unity of geographical space and the society that occupies it. According to this theory, people create geographical space, and conversely, this space affects human behavior and community relationships. The theory describes the relationship between communities and geographical space and translates that relationship into specific values, which can be used to rather accurately predict relations between geographical space and social processes.

Space Syntax is a notion related to the theory and tools used to analyze mechanisms behind collective human behaviors encountered across urban space (Hillier 1996). The analysis of human flow across geographical space makes it possible to determine, at least to some extent, the conditions needed to generate movement. The motives that prompt pedestrians to traverse the geographical space may be explained in terms of mutually determining external and internal relationships.

Space Syntax Theory can help link quantitative and qualitative research methods. The potential of pedestrian traffic in an urban space directly affects the passenger load of public transport vehicles and constitutes a variable that represents human behavior. The most common space syntax methods include Visibility Graph Analysis (VGA) (Turner *et al.* 2001) and Inter Connection Density (ICD), both of which effectively predict the direction and density of pedestrian traffic.

The basic procedure for modeling movement using Space Syntax Theory is to calculate the relationship between lines in a set of axial lines that follow pedestrian footsteps – their number, direction and location of nodes. Algorithms can be used to show topological accessibility based on the frequency of journeys and not based on physical accessibility, as is the case in traditional models. The final result of this type of analysis is an output map (see Fig. 1.) that can be made available at any scale and that identifies the potential of each element of the urban network.

The space syntax model of the city makes it possible for urban planners to perform analyses at both the macro level and the micro level. The same model can be used in short-term and long-term simulations, which helps to quickly generate alternative scenarios. Given an analysis of all the connections in a city, it is possible to simulate pedestrian traffic at planned public transport hubs. This may help answer two questions: 1) How will planned public transport systems affect pedestrian traffic in a given area? 2) Is potential pedestrian traffic in a given quartile sufficient to warrant a hub at that location?



Legend: red – high accessibility, blue – low accessibility.

Fig. 1. An output map of axial-based spatial accessibility of London

Source: www.spacesyntax.com

Traffic is affected by a variety of factors, which is why a single equation cannot be used to describe all human behaviors. Nevertheless, an understanding of how spatial structure affects traffic can be quite helpful in transport planning. Many human behaviors are closely linked to pedestrian traffic, which in turn, affects passenger volumes aboard public transport vehicles. Research studies in various countries have shown that space syntax analysis is helpful in the forecasting of the presence of heterogeneous users, locations of top-selling office space, and real estate prices (Hillier, Hanson 1984; Enström, Netzell 2008).

Further research is needed on the components of geographic space in order to better understand how the geometric network of urban connections affects society. The use of an integrated approach in space syntax analysis would make it possible to test the theory in a transport context.

Conclusions

Geography is a key part of transport research and helps to supplement other areas of research in this discipline and in other disciplines. Models utilized to predict the size and direction of traffic need to be tested much more thoroughly in order to verify the results of simulation. The main challenge for researchers studying issues associated with mobility is to better understand which qualitative factors create a positive or negative travel experience as well as to discover how mobility can be better understood, especially in terms of future trends.

The issue of transport should not be viewed in absolute terms. Both quantitative and qualitative research is needed to explain transport processes. The choice of research method should depend on the problem, which should be well defined. In some cases, a one-sided approach may be sufficient. However, the research literature suggests that quantitative methods are often preferred due to the methodological problems associated with qualitative methods. This type of approach may not capture all the details of a research problem and may yield inaccurate forecasts that may produce negative social and economic consequences. The starting point in transport research varies depending on the research subject.

Geography, as the interdisciplinary science, is predisposed to take a holistic look at urban transport issues with a focus on local characteristics of geographic space and the most important of all reference points – the man. Research in the field of geography involves complex analyses based on quantitative and qualitative methods. The geographic approach to transport research focuses on the actual needs of pedestrians and riders when planning an urban transport system.

One research approach worth considering is advanced spatial analysis in support of urban transport planning. Advanced pre-project studies based on space syntax analysis and environmental psychology could constitute a good starting point for the formulation of spatial and community-oriented recommendations that would provide knowledge on the transport potential of a given section of a city. An interdisciplinary approach to transport research could help reveal the long-term effects of the planning

process at the early stage of the planning process, which would help create solutions based on actual community needs.

A comprehensive look at mobility based to some extent on empirical data could help transport planners produce a well-functioning transport system. The contemporary focus on mobility is an opportunity for geographers and may very well contribute to a renaissance of the discipline with benefits for society and geography itself. In light of the dearth of Polish research studies on the effects of so-called soft quality on transport, especially in urban areas, most of the papers cited herein are the foreign ones.

While many detailed problems remain to be solved, alternative approaches to forecasting research and traffic studies appear to be important steps towards a better understanding of the nature of transport.

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